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Degrees of Success: Evaluating the Environmental Impacts of Long Term Settlement in South Iceland

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INTRODUCTION

It is widely argued that early Norse settlement had a considerable impact on the previously 'pristine' Icelandic environment (Þórarinnsson 1961; Einarsson 1963; Hallsdóttir 1987), but these changes have rarely been considered in relation to more detailed patterns of human settlement. Although at one level it is valuable to consider only the settlement and abandonment of farms with relation to environmental impact and change (Sveinbjarnardóttir 1982, 1983, 1992), evaluation of the complex record of

varying degrees and levels of impacts associated with continuous human occupation are the next key level of investigation. A model by Vésteinsson *et al.* (2002) has highlighted a hierarchy of principle settlement types in Iceland, dividing occupation patterns between what they termed large complex settlements, large simple settlements and planned settlements. The aim of this paper is to recognise and assess some of these differences in settlement strategy and assess how they are manifested in the environmental record and economic and social landscape.

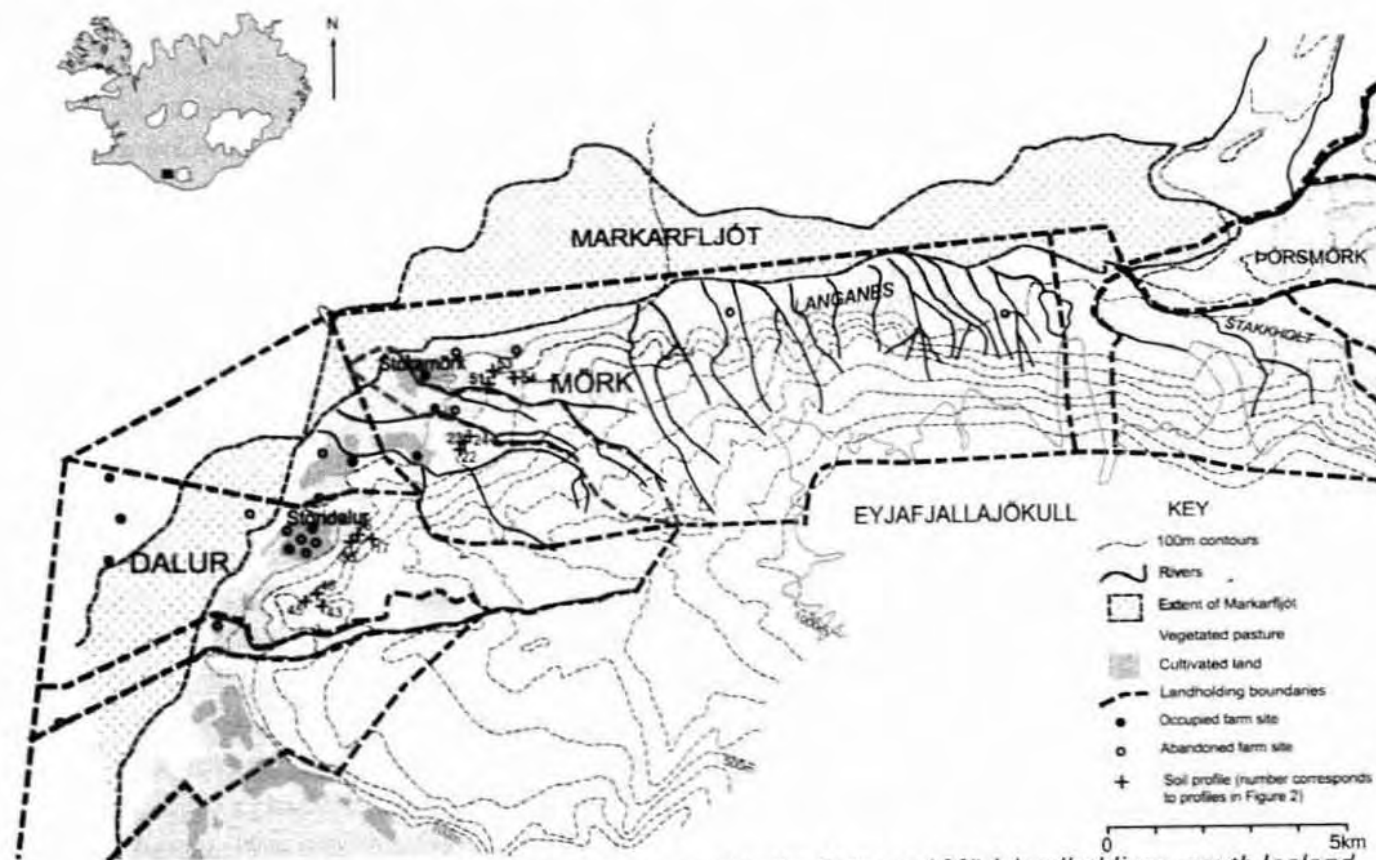


Fig. 1. The location of occupied and abandoned farms within the Dalur and Mörk landholdings, south Iceland.

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THE STUDY AREA

The western part of the district of Eyjafjallahreppur, south Iceland, is defined by the Markarfljót River to the west and north and the Eyjafjöll Mountains to the east (Fig. 1). It is a study area that is large enough to have supported up to 38 settlement sites, and so may be considered to form a landscape-scale study area. A chronology of farm occupation and abandonment and patterns of landownership has been established for much of the *hreppur* (district) by Sveinbjarnardóttir (1992) and Sveinbjarnardóttir *et al.* (this volume).

In addition, high resolution temporal control based on tephrochronology allows the environmental record to be analysed at a relevant resolution of years to decades (Þórarinnsson 1944, 1967, 1980; Larsen 1981, 1982, 1984; Dugmore 1987, 1989; Larsen *et al.* 1999).

Within the study area, three principal farm groupings at Dalur, Mörk and Seljaland date from the early settlement period according to high medieval sources, with many other settlements either established as dependent settlements or on land derived from these farms (Sveinbjarnardóttir *et al.* this volume). With the ebb and flow of settlement many dependent farms have come and gone; for example, six dependent farms related to Seljaland were established and abandoned between the 16th and 17th centuries. The farm site and church at Dalur have, however, endured, as have most of the farms that possessed chapels. Seljaland, Syðstamörk, Miðmörk, and Stóramörk have become sites of long-term occupation, only Neðridalur has been abandoned, and even then, not until the 20th century.

In order to evaluate the environmental nuances of long-term settlement we focus on the farm groupings of Mörk, incorporating the farms with chapels, Stóramörk, Miðmörk and Syðstamörk, and the group of up to 15 farms related in some way to the ecclesiastical centre and principle farm Stóridalur. Today, the landscapes of Dalur and Mörk have a similar outward appearance. Both settlement clusters have extensive and historically-productive home fields compared to the other farms in the study area and have access to additional resources out with the farm including rangeland grazing, woodland and driftwood rights (Sveinbjarnardóttir *et al.* this volume). We wish to assess if

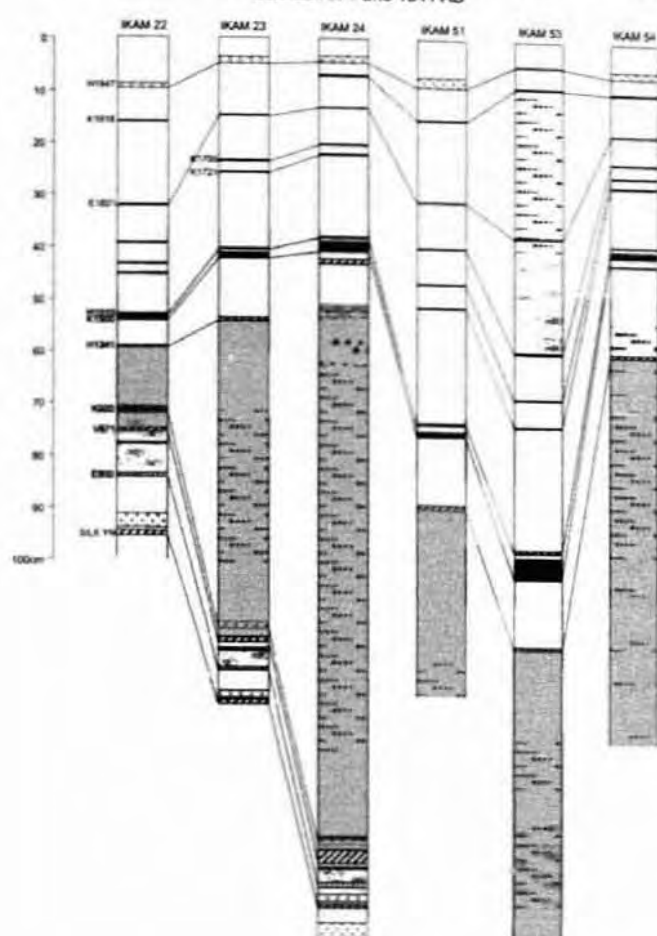
their similar contemporary outward appearance and overall success conceals different landscape histories.

APPROACH AND METHODS

The initial stage of the research involved a collection of the existing farm survey data and landholding boundaries (Sveinbjarnardóttir 1992; Sveinbjarnardóttir *et al.* this volume), which provided the framework for our environmental studies. In addition to the land boundary data being used to define the location of the sediment stratigraphies, it was also applied to a location map that allowed a visual representation of settlement, abandonment, farm status and resource rights. The maps enabled the clear identification of similarities and differences between the farm groupings and comparison between the stratigraphic data and evidence cited in literary and archaeological sources.

In different land holdings stratigraphic profiles were investigated in comparable suites of geomorphological settings, including areas of extensive and limited vegetation cover, different soil depths, altitudinal ranges, and settings on slopes. In order to encompass the wide variety of environments present across the landscape the profiles were located where soil was present, at increasing elevations and distance from the farm sites across a range of landforms, including riverbanks and gullies, the valley floor, low altitude slopes and high altitude plateaux. Fifty soil and peat profiles containing a total of 447 tephra layers were recorded and analysed. Data were then combined in different ways to represent changes across the landholding. Sediment accumulation rates and patterns were calculated from the stratigraphic profiles by measurement between tephra of known age (Þórarinnsson 1961; Dugmore and Buckland 1991). From the sediment accumulation rate data further calculations of the mean sediment accumulation rate, median accumulation rate and the standard deviation from the mean sediment accumulation rate were made. This provides information concerning changes in groundcover and changes in the sediment supply, which are indicative of the stability or instability of the landscape (Dugmore and Erskine 1992). The tephra themselves constitute another independent line of evidence with

Mörk profiles: Characterised by a high sediment accumulation rate between 871 and 1341 AD



Dalur profiles: Characterised by a low sediment accumulation rate between 871 and 1341 AD

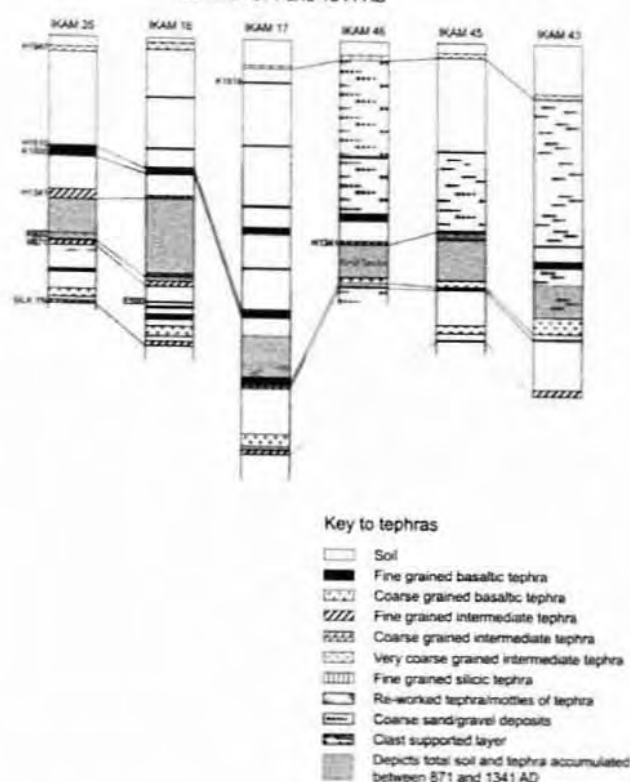


Fig. 2. Soil sections from Dalur and Mörk that illustrate the comparison of sediment accumulation rates between the two settlements from 871 to 1341 AD.

layer characteristics such as thickening, existence of multiple layers or layer absence as a result of non-deposition or erosion being indicative of environmental change (Dugmore *et al.* 2000).

LANDSCAPE HISTORIES

Dalur

As shown in Fig. 2, sediment accumulation rates (SARs) are low in the pre-Landnam period (before the deposition of the Landnám tephra and the Norse colonisation of the late ninth century), consistent with profiles across the valley and wider regional data (e.g. Dugmore and Buckland 1991; Dugmore and Erskine 1992). The first significant increase in the sediment accumulation rate within Dalur is identified between 871 and 920 AD. After this significant early peak, accumulation rates decrease and remain comparatively stable for nearly 600 years. The SAR only begins to increase again significantly after 1500 AD, probably as a result of the breaching of the vegetation cover on

the slopes above the farm (a process that occurred earlier elsewhere in the study area). Despite the early disturbance recognised in the environmental record, in comparison with profiles from other landholdings in the valley (Dugmore and Buckland 1991; Dugmore and Erskine 1992; Mairs 2003), sediment accumulation rates have been comparatively low and there has been little re-working of sediment indicative of the relative stability and resilience of the Dalur landholding throughout the historic period.

Mörk

As with Dalur, sediment accumulation rates are low in pre-Landnám times and the first significant increase occurs after the deposition of the Landnám tephra (c. 870 AD), consistent with the traditional date of arrival of people in Iceland (see Fig. 2). Less than fifty years after the first indication of settlement in the sediment profiles, the environmental records of Dalur and Mörk begin to diverge, indicating that the two landholdings began to dis-

play diverging catchment histories. Whereas sediment accumulation rates in Dalur decrease after 920 AD, at this time in Mörk substantial sediment flux variations begin and continue to develop through the late 10th to late 14th centuries, the SAR increasing to nearly four times the c. 870-920 AD average, from 0.53 mm/yr before 870 AD to 1.96 mm/year after 920 AD. Between 920 and 1341 AD, the SAR average and assumed erosion around Mörk is greater than at any other settlement in the area, even in inland Þórsmörk where settlements were completely abandoned by the 13th century (Dugmore *et al.* this volume). Despite such considerable early landscape instability around Mörk, the settlement was not abandoned and the sediment flux eventually decreased, signalling a period of landscape re-stabilisation between 1341 and 1755 AD. While sediment accumulation rates from Dalur increased after 1510, they gradually declined at Mörk to reach their lowest level since settlement, before increasing again in the mid-eighteenth century, coincident with the timing of a glacial maximum in this area (Kirkbride and Dugmore 2001).

DISCUSSION

The oldest settlement in the study area is likely to have been located in the homeland of Dalur (Sveinbjarnardóttir *et al.* this volume), which after the conversion of Christianity at around AD 1000 became an ecclesiastical centre of the area. Despite being a very heavily settled landholding (in terms of the number of dependent/derived farms) and having a long occupation history, average sediment accumulation rates throughout the post-landnám period have remained consistently low compared with that of other settlements, and the continued impact of settlement has not led to significant local landscape degradation (Mairs 2003). At the outset of this research, it was hypothesised that such intensive settlement and exploitation would cause considerable degradation. Instead, it is proposed that a large complex settlement such as Dalur was successful through the exploitation of a range of resources over a wide geographical area, 'thinning out' or 'buffering' the environmental impacts across a larger area and thus minimising local degradation that would affect the principle

farm. In this respect the establishment and abandonment of subsidiary settlements can be seen as a mark of a flexible and effective management strategy. Although the environment around Dalur was probably more ecologically resilient than elsewhere in the area, this environmental argument alone does not explain such low rates of degradation. Mörk, for example, is adjacent to Dalur in a comparative topographic catchment, yet rates of degradation are higher.

Despite appearing similar in outward appearance to Dalur today, place-name evidence, palaeoenvironmental data from the soil, environmental reconstructions and peat profiles closely dated with tephrochronology indicate that the pre-settlement environs of Mörk were dominated by woodland. Key macrofossil evidence of birch wood pieces (*Betula pubescens* L.), with some trunk sections as large as 240 mm in diameter were found in peat in exposed ditch sections within the current hayfields of Mörk (Fig. 3). With a number of tephra covering this critical early period including the 871 Landnám layer, the 920 from the eruption of Katla and the 935 from Eldjá, the timing of impacts on the early vegetation and landscape can be evaluated precisely. The change in stratigraphy from a black to brown peat at a point mid-way between the Landnám tephra of 871 AD and the Katla tephra of 920 AD (i.e. c. 895 AD) is coincident with the complete disappearance of birch macrofossils from the section. The change is not due to differential preservation in an aggrading section because although humification in the upper peat is low and organic preservation is good, large (100 m-scale) exposures within ditches contain no tree remains. This evidence suggests that in the vicinity of the Mörk farms, relatively dense birch woodland was rapidly cleared from the area within less than fifty years of the first settlement, in agreement with palynological research undertaken elsewhere (Haraldsson 1981; Hallsdóttir 1987). Also, a radiocarbon date of late 9th to 10th century calAD date (1150 ± 40: GU-11664) was produced from a sample of birch charcoal taken from the bottom of a probable charcoal production pit discovered by Guðjón Ólafsson and sampled in the mid 1990's, within the upper areas of the infield of his farm in Syðstamörk. This demonstrates the antiquity of charcoal production for metalworking in the area, one of the key uses of birch wood throughout the history of Iceland, and high-

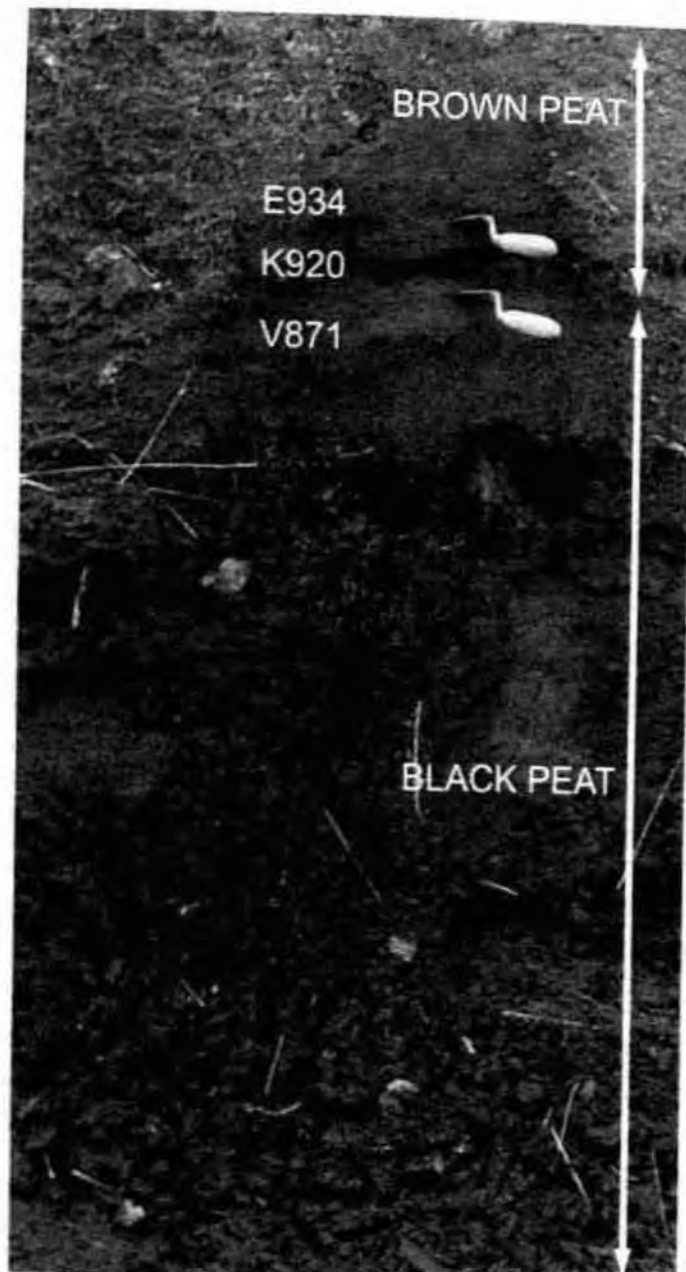


Fig. 3. Left: Mörk ditch section illustrating the position of the V871, K920 and E934 tephra layers. The lower trowel marks a change in stratigraphy from a black to brown peat. Right: Birch wood trunk section preserved in peat in the Mörk ditch section.

lights the role the practise had for human impact on the environment.

The removal of woodland from Mörk and the surrounding slopes in the early 10th century liberated a considerable volume of sediment that had previously been stabilised by the surface vegetation. This process is highly visible in the environmental record as sediment accumulation rates increase dramatically after 920 AD implicating increasing sediment flux, erosion and re-working. The tephra layers are themselves informative as indicators of change. The Veidivötn 871 Landnám tephra is fairly uniform in thickness in the profiles from the Mörk landholdings, despite deposition on quite different slope angles, yet the Katla 920 tephra exhibits considerable variability in thickness

across a transect of profiles through the landholding (Fig. 4). We conclude that the widespread clearance of trees and disturbance of surface vegetation (that had stabilised the deposition V871 tephra), allowed the K920 tephra to be moved down slope and be re-worked by the wind and water. This created a distinct variation in the thickness of the K920 tephra: on the slopes above Mörk the tephra layer is generally up to 2 cm thick, at the base of the slope in the Mörk infields, re-worked K920 deposits exceeds thicknesses of 50 cm. This contrasts with a considerably lower variability in the thickness of the K920 tephra from profiles within the neighbouring Dalur. From this we can conclude that the degree of surface vegetation change in the two areas was notably different by the early 10th century.

From assessment of the Geodetic Survey topographic maps which document the extent of marsh and wet meadow before 20th century land-improvement projects in the area, and assuming that birch

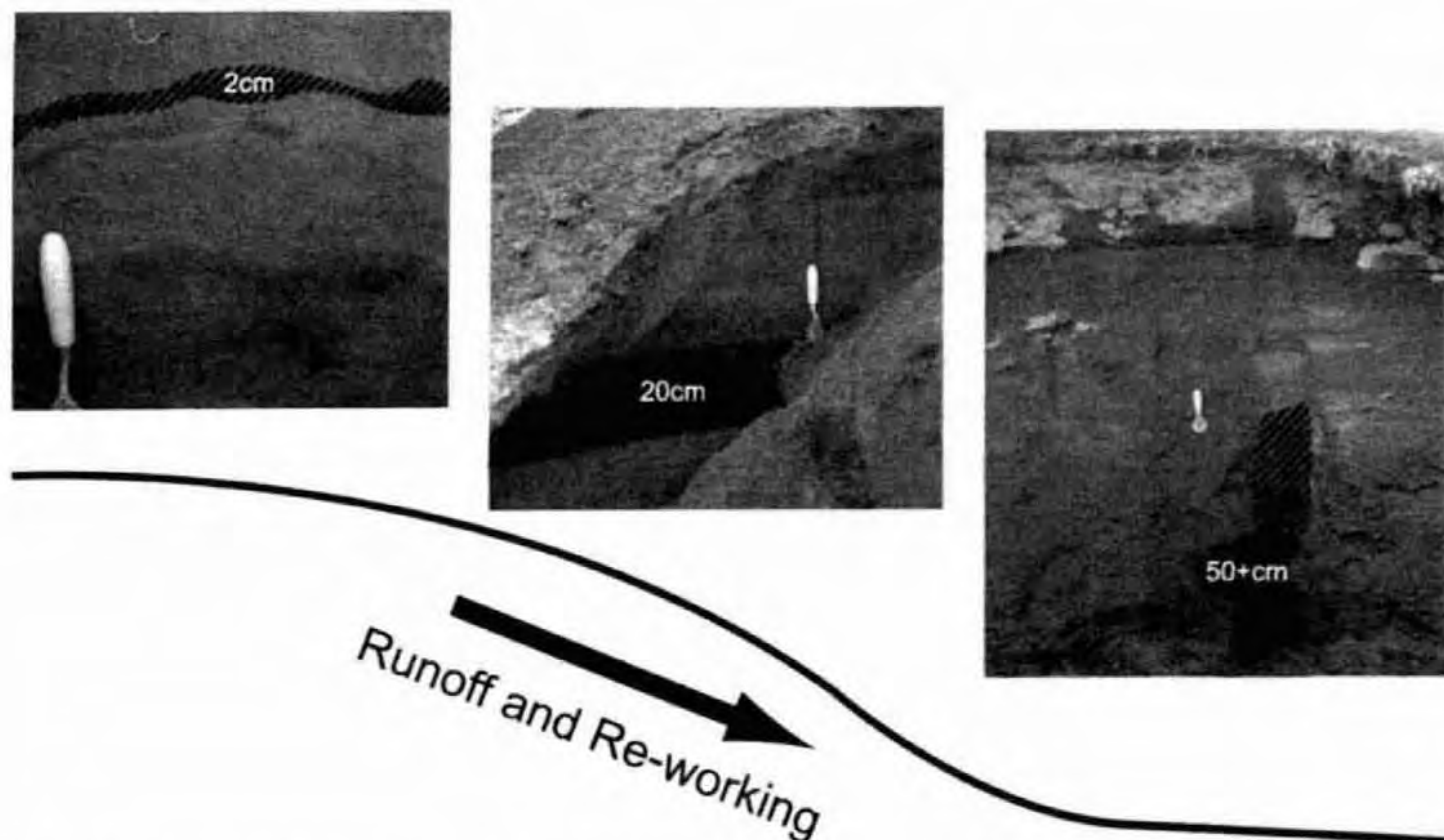


Fig. 4. Variability in the thickness of K920 tephra caused by re-working after the removal of woodland.

trees can grow up to an altitude of about 250-300 m (Kristinsson 1998) it is possible to model the possible extent of woodland prior to deforestation. At the time of settlement, Dalur was located close to the low lying flood plain Markarfljót, and altitudes to 50 m were dominated by marsh. Above the infields the slopes rise relatively steeply to a gently sloping extensive upland above 400 m. As a result only a small percentage of land is located above the marshy lowland plains but below 300 m, and so it is likely that only a correspondingly small area of land that would have been wooded. The landholdings of Mörk on the other hand comprised little low altitude marsh land. The Mörk farms are set back from the river on rolling terminal moraines and behind them the slopes of the margins of the Eyjafjallajökull massif are comparatively shallow, with a significant percentage of well-drained land lying beneath the 300 m contour and accordingly within the tree-line. Although the Mörk area was a good prospect for settlement, Dalur would most likely have been a favoured place for the earliest settlements because the area was easily accessible with extensive meadow and grassland available for immediate haymaking and grazing which was the mainstay of

traditional Norse farming. Accordingly the first settlers to the area did not need to expend valuable time and effort in woodland clearance to modify the landscape for pastoral farming (cf. Amorosi *et al.* 1998). This reduced the scale of rapid ecological change and probably ensured that vegetation cover was not breached for some time, with soil erosion kept at a minimum. Mörk, with a pre-settlement landscape that was dominated by woodland and scrub, would have needed to be cleared before the production of hay for animal fodder could begin and accordingly the vegetation experienced a period of rapid and massive change that could have caused considerable local erosion.

The relatively low incidence of erosion around Dalur illustrates that extensive settlement and subsidiary farm establishment and abandonment is not in itself critically detrimental to the environment, and that the abandonment of farms not necessarily a reaction to environmental degradation. Land degradation is a complex issue concerned with the specific ways that people interact with the landscape and influenced by the decisions made by the new settlers. The nature of settlement change at Dalur implies that it was principally related to non-

environmental changes, and may more usefully be related to socio-political factors such as a property requirement for marriage which drove the proliferation of independent households.

Mörk had to be managed differently because of differences in the primary vegetation cover facing the first settlers. Rapid vegetation clearance in the early settlement period caused a dramatic surge of soil erosion. However, unlike the further inland settlements of Þórsmörk which were abandoned early partly as a result of environmental degradation (Dugmore *et al.* this volume), the Mörk farms probably had considerable additional access to grazing and woodland out with the principle landholdings. Dating of charcoal pits in the wider area of Langanes and Gígjökull illustrate that although woodland around Mörk was cleared rapidly in the late 9th century, woodland clearance out with the immediate farm was a slower, more progressive process as indicated by the archaeological evidence of charcoal production in Langanes up to but not after the early 14th century (Dugmore *et al.* this volume). Even further inland in Þórsmörk, harvesting wood for charcoal production continued into the 20th century and the woodland still survives (Tómasson 1996; Dugmore *et al.* this volume). This pattern of landscape change highlights the importance of extensive and complex resource networks for settlement survival and ultimate success in this part of southern Iceland.

CONCLUSIONS

The farm groupings of Dalur and Mörk can be described within the farm classification suggested by Vésteinsson *et al.* (2002) as a large complex settlement and large simple settlement respectively. Large complex settlements are suggested as occupying land that had rich meadows and access to a wide range of resources including upland pasture, lowland meadow, hunting access and a good fuel and water supply. Large simple settlements are described as occupying land that may only have been accessible after forests had been cleared and had less meadow and variety of resources than large complex settlements although still had reasonable access to alternative resources (Vésteinsson *et al.* 2002). This classification can be used to explore and evaluate differences between

the currently similar looking settlements of Dalur and Mörk. It is concluded that key differences exist as a result of the environmental setting of a settlement, the extent of vegetation change and access to resources.

- Pre-settlement environment – while the pre-settlement vegetation of the Dalur environs was dominated by wet-meadow and grassland, the pre-settlement vegetation of the Mörk environs was dominated by woodland. These differences may not only have influenced initial settlement decisions, but also pre-determined the extent of landscape change between neighbouring settlements.
- Degrees of impact/extent of change – when Mörk was first settled, the vegetation underwent a major change as the area was cleared of woodland and this disruption exacerbated soil erosion. The pre-existing, relatively open landscape of Dalur did not need to be modified so drastically for agriculture and so the human impact was less.
- Patterns of occupation – the longevity of the Dalur and Mörk farms can be related to a different, but effective pattern of occupation.
- Access to resources – although the vegetation of Mörk had changed, causing considerable erosion and landscape degradation, this was managed and the settlement survived. Alternative resources and landholdings outside the immediate farm provided Mörk with greater opportunities and a buffer against landscape degradation that was not available to smaller, farms elsewhere in the valley.

We conclude that the subject of farm abandonment, particularly with reference to soil erosion, may alternatively be approached through evaluation of the complex and varying record of human impact at those farms that have a long term history of settlement.

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REFERENCES

- Amorosi, T., Buckland, P. C., Edwards, K. J., Mainland, I., McGovern, T. H., Sadler, J. P. and Skidmore, P.
1998 They did not live by grass alone: the politics and palaeoecology of animal fodder in the North Atlantic Region. *Environmental Archaeology* 1: 41-54.
- Dugmore, A. J.
1987 *Holocene Glacial Fluctuations Around Eyjafjallajökull, South Iceland*. Unpublished PhD Thesis, University of Aberdeen.
1989 Tephrochronological Studies of Holocene Glacier Fluctuations in Southern Iceland. In Oerlemans, J. (ed.), *Glacial Fluctuations and Glacial Change*, Dordrecht, Kluwer Academic Publishers, pp. 37-55.
- Dugmore, A.J. and Buckland, P. C.
1991 Tephrochronology and late Holocene soil erosion in South Iceland. In Maizels, J. and Caseldine, C. (eds.), *Environmental Change in Iceland*, Dordrecht, Kluwer Academic Publishers, pp. 147-159.
- Dugmore, A. J. and Erskine, C. C.
1994 Local and regional patterns of soil erosion in southern Iceland. *Münchener Geographische Abhandlungen* 12: 63-79.
- Dugmore, A. J., Newton, A. J., Larsen, G. and Cook, G. T.
2000 Tephrochronology, environmental change and the Norse colonisation of Iceland. *Environmental Archaeology* 5: 21-34.
- Einarsson, T.
1961 Pollenanalytische untersuchungen zur spat- und post-glacialen klimatschichte Islands. *Sonderveröff. der Geol. Institut Univer. Köln* 6: 1-52.
1963 Pollen analytical studies on the vegetation and climate history of Iceland in Late and Post-Glacial times. In Löve, A. and Löve, D. (eds.), *North Atlantic biota and their history*, Pergamon Press, Oxford, pp. 355-365.
- Hallsdóttir, M.
1987 *Pollen analytical studies of human influences on vegetation in relation to the Landnám tephra layer in southwest Iceland*. Published PhD Thesis, Department of Quaternary Geology, Lund University.
- Haraldsson, H.
1981 The Markarfljót sandur area, southern Iceland. Sedimentological, petrological and stratigraphical studies. *Striae* 15: 1-60.
- Kirkbride, M.P. and Dugmore, A.J.
2001 'Can lichenometric dating be used to date the 'Little Ice Age' glacial maximum in Iceland?' *Climatic Change* 48: 151-167.
- Kristinsson, H.
1998 *Flowering plants and ferns of Iceland*. Grafík hf, Reykjavík.
- Larsen, G.
1981 Tephrochronology and microprobe glass analysis. In Self, S. J. and Sparks, S. (eds.), *Tephra Studies*, Dordrecht, Reider D., pp. 95-102.
- Larsen, G.
1982 Gjósikututímatal Jökuldals og Nágrennis (Tephrochronology of Jökuldalur and the surrounding area). In Þórarinsdóttir, H., Óskarsson, Ó., Steinþórsson, S. and Einarsson, Þ. (eds.), *Eldur í Norðri*, Sögufélag, Reykjavík pp. 51-65.
- Larsen, G.
1984 Recent volcanic history of the Veidvötn fissure swarm, Southern Iceland – an approach to volcanic risk assessment. *Journal of Volcanology and Geothermal Research* 22: 33-58.
- Larsen, G., Dugmore, A.J. and Newton, A.J.
1999 Geochemistry of historical age silicic tephras in Iceland. *The Holocene* 9: 463-471.
- Mairs, K-A.
2003 *Farm settlement and abandonment in Iceland: An analysis of human-environment interactions*. Unpublished MSc Thesis. Institute of Geography, University of Edinburgh.
- Sveinbjarnardóttir G.
1982 Byggðaleifar við Einhyrningsflatar í Fljótshlíð. In Þórarinsdóttir, H., Óskarsson, Ó.H., Steinþórsson, S. and Einarsson, Þ. (eds.), *Eldur er í norðri*. Sögufélag, Reykjavík: 67-77.

- 1983 Byggðaleifar á Þórsmörk. *Árbók Hins íslenska forn-leifafélags* 1982: 20-61.
- 1992 *Farm abandonment in Medieval and Post-medieval Iceland: an interdisciplinary study*. Oxbow Monograph 17. Oxbow books, Oxford.

Tómasson Þ.

- 1996 *Þórsmörk. Land og saga*. Mál og mynd, Reykjavík.

Vésteinsson, O.

- 1998 Patterns of Settlement in Iceland. A Study in Prehistory. *Saga-Book* 25, 1-29.

Vésteinsson, O., McGovern, T. H. and Keller, C.

- 2002 Enduring Impacts: Social and environmental Aspects of Viking Age Settlement in Iceland and Greenland. *Archaeologica Islandica* 2: 98-136.

Þórarinnsson, S.

- 1944 Tefrokronologiska studier på Island. *Geografiska Annaler* 26: 1-217.
- 1961 Uppblástur á Íslandi í ljósi öskulagarannsóknna (Wind erosion in Iceland. A tephrochronological study). *Ársrit Skógræktarfélags Íslands* 1961: 17-54.
- 1967 The eruptions of Hekla in historical times. *The eruption of Hekla 1947-1948* 1: 1-170.